Complete Summary

GUIDELINE TITLE

ACR Appropriateness Criteria® headache - child.

BIBLIOGRAPHIC SOURCE(S)

Prince JS, Gunderman R, Coley BD, Blatt ER, Bulas D, Fordham L, Karmazyn BK, Podberesky DJ, Paidas C, Rodriguez W, Expert Panel on Pediatric Imaging. ACR Appropriateness Criteria® headache--child. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 6 p. [38 references]

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Strain JD, Cohen HL, Fordham L, Gunderman R, McAlister WH, Slovis TL, Smith WL, Rothner AD, Expert Panel on Pediatric Imaging. Headache--child. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 6 p. [36 references]

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Headache in children, including

- Isolated headache

- Headache with positive neurologic signs or symptoms
- Acute severe (thunderclap) headache
- Migraine with or without aura

GUIDELINE CATEGORY

Diagnosis
Evaluation

CLINICAL SPECIALTY

Family Practice
Neurology
Pediatrics
Radiology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for children with headache

TARGET POPULATION

Children with headache

INTERVENTIONS AND PRACTICES CONSIDERED

1. Computed tomography (CT) of the head, with and without contrast
2. CT angiography (CTA) of the head
3. Magnetic resonance imaging (MRI) of the head, with and without contrast
4. Magnetic resonance angiography (MRA) of the head, without contrast
5. Invasive (INV), cerebral arteriography

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of peer-reviewed medical journals, and the major applicable articles were identified and collected.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed for reaching agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1 to 9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a

consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

The guideline developers reviewed a published cost analysis.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria®

Clinical Condition: Headache — Child

Variant 1: Isolated headache (unaccompanied by neurologic signs and symptoms or historical data).

Radiologic Procedure	Rating	Comments	RRL*
CT head without contrast	2		High
CT head with contrast	2		High
CTA head	2		High
MRI head without contrast	2		None

Radiologic Procedure	Rating	Comments	RRL*
MRI head with contrast	2		None
MRA head without contrast	2		None
INV arteriography cerebral	2	Not an initial test.	High
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Headaches with positive neurologic signs or symptoms.

Radiologic Procedure	Rating	Comments	RRL*
CT head without contrast	8	CT or MRI should be performed in every patient.	High
MRI head without contrast	8	CT or MRI should be performed in every patient.	None
MRI head with contrast	7	See comments regarding contrast in the text below under "Anticipated Exceptions."	None
CTA head	6	Indicated if subarachnoid or parenchymal blood is identified on CT, MRI, or LP. Either CTA or MRA, not both.	High
MRA head without contrast	5	Indicated if subarachnoid or parenchymal blood is identified on CT, MRI, or LP. Either CTA or MRA, not both.	None
CT head with contrast	3		High
INV arteriography cerebral	2	Not an initial test.	High
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: Acute severe (thunderclap) headache and absence of family history of migraine.

Radiologic Procedure	Rating	Comments	RRL*
CT head without contrast	9	CT or MRI should be performed in every patient.	High
MRI head without contrast	8	CT or MRI should be performed in every patient.	None
MRA head without contrast	7	Indicated if subarachnoid or parenchymal blood is identified on CT, MRI, or LP. Either CTA or MRA, not both.	None
CTA head	7	Indicated if subarachnoid or parenchymal blood is identified on CT, MRI, or LP. Either CTA or MRA, not both.	High
INV arteriography cerebral	6	If MRA or CTA not available or if intervention is considered.	High
CT head with contrast	2		High
MRI head with contrast	2		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 4: Migraine with or without aura (without neurologic findings).

Radiologic Procedure	Rating	Comments	RRL*
CT head without contrast	2		High
CT head with contrast	2		High

Radiologic Procedure	Rating	Comments	RRL*
CTA head	2		High
MRI head without contrast	2		None
MRI head with contrast	2		None
MRA head without contrast	2		None
INV arteriography cerebral	2	Not an initial test.	High
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Headache is very common in children. The prevalence of headaches in patients 7 years of age or younger is 19% to 51%, with migraine representing 1% to 5%. In large cross-sectional studies, 60% of children 7 to 15 years of age suffered from headaches, and 3% to 4% suffered from migraines. In a U.S. study, the prevalence of headaches in adolescents was 56% for boys and 74% for girls, with migraines accounting for 3.8% and 6.6%, respectively.

The majority of pediatric headaches are benign. Imaging in these patients shows a low rate (0.9% to 1.2%) of significant findings. The majority of imaging studies in patients with headache are normal. Occasionally, headache heralds the development of a brain tumor or other structural abnormality in a child. However, the annual incidence of brain tumor in the pediatric age group approximates only three per 100,000 (0.003%). The need to distinguish headaches due to other causes from headaches due to structural abnormalities presents a major dilemma. A review of the literature finds that most articles on this subject are retrospective case series. Reviews from pediatric neurology or pediatric neurosurgical referrals bias the data when evaluating structural anomalies associated with headache. Similar bias comes from retrospective reviews provided through large brain tumor consortiums. It is difficult to assess the health outcome of early detection of any intracranial lesions, because the type, size, and location determine their management. These issues are not unique to the pediatric patient; they have also been discussed in a series of adult literature reviews. Clinical experience of primary care physicians, pediatricians, and neurologists indicates that neuroimaging studies have a limited role in children with headaches.

The high prevalence of headaches and the low yield of imaging in pediatric patients presenting with headaches alone bring into question the value of screening for patients with "isolated" headaches. There are, however, clinical conditions that influence the yield of positive examinations. Numerous studies, most of which are retrospective, help identify those findings or clinical characteristics that, when associated with headaches, appear to be useful predictors of positive imaging evaluation and therefore influence the appropriateness of imaging. There are no data to support imaging a child with an isolated headache unaccompanied by neurologic signs, presence of a seizure, or supporting patient historical data.

Headaches with Positive Neurologic Signs or Symptoms

Major studies addressing the issues of brain tumors and indications for imaging, including the data from 3,291 children described in the Childhood Brain Tumor Consortium, 315 children in the Boston Children's review, and 72 children in the data of Honig and Charney, suggest that nearly all children with intracranial tumors had symptoms or neurologic signs accompanying their headache. The data from the Childhood Brain Tumor Consortium and the Honig and Charney study showed that 94% of children with brain tumors had abnormal neurologic findings at diagnosis and 60% had papilledema. Other neurological findings included gait disturbance, abnormal reflexes, cranial nerve findings, and altered sensation. Another research team identified papilledema, nystagmus, and gait disturbances as univariant predictors of brain tumor. Confusion and other assorted abnormal neurological findings were multivariant predictors of brain tumors. It would appear appropriate from this retrospective data to consider intracranial imaging in any patient presenting with headache and positive neurologic findings.

Supporting Patient Historical Data

There also appear to be specific patient historical data or headache characteristics that are associated with intracranial pathology. Headaches that awaken the child from sleep or occur on arising appear to have clinical significance. Intense, prolonged, and incapacitating headaches with an absent family history for migraine may indicate an underlying pathology. Patients with headaches increasing in frequency, duration, and intensity might benefit from imaging. Vomiting accompanied headaches in 78% of patients in the study by Honig and Charney, and it was also predictive of pathological process in the study by other researchers. Individuals who have these specific historical data of headache characteristics may benefit from neuroimaging.

Sudden Severe Headache (Thunderclap Headache)

Sudden severe headaches are more common in adults than in children. These "thunderclap headaches" are associated with subarachnoid and intracranial hemorrhage that may occur with aneurysm or arteriovenous malformations. Although childhood intracranial aneurysms are rare, many case reports document severe acute headache as the presenting symptom. Sudden severe unilateral headaches in the pediatric population and in young adults correlate with carotid or vertebral dissection, especially when associated with neurologic signs and symptoms. In sudden severe headaches, particularly in the absence of a family history of migraine, neuroimaging with a computed tomography (CT) scan without

contrast has been advocated. If subarachnoid or parenchymal hemorrhage is detected, further evaluation for aneurysm or vascular malformation must be performed. This can be accomplished by CT angiography (CTA) or magnetic resonance angiography (MRA). If a malformation is not detected by either of these methods, catheter angiography should be considered. Catheter angiography may provide more definitive information regarding a vascular lesion and may also be considered for neurovascular intervention.

Migraine with or without Aura

By 15 years of age, 3% to 10% of children experience migraine headaches. There is a female predominance. In 1988 the International Headache Society described two types of migraine: migraine with aura (classic), and migraine without aura (common). It reported that 17% of patients with migraine headaches had an accompanying aura. The most common associated symptoms are nausea, vomiting, abdominal pain, and disturbance of vision. Visual symptoms include scintillating scotomata, blurriness, transient hemianopia, or complete blindness in one eye (amaurosis fugax). A family history of the disorder can be elicited in more than half of the patients. Other symptoms include numbness and tingling in one arm or over the entire side, hemiplegia, aphasia, or apraxia.

Clinicians can have difficulty distinguishing the first, second, or third migraine headache from headache caused by brain tumor, subarachnoid hemorrhage, vasculopathy, arteriovenous malformation, or other underlying disease processes. These patients may be imaged before the diagnosis of migraine is established. One of the clues in differentiating these headaches may relate to transient neurologic findings versus persistent findings in tumor headaches. In a study of 72 patients with brain tumor headaches abnormal physical signs were present in 94%.

Migraine may have many manifestations. If there is a pattern to the headaches it is usually not difficult to diagnose. Children with migraines are symptom-free between headaches. If the child has typical migraine with or without aura, most clinicians would recommend no imaging studies. No imaging is also recommended in cases of common migraine of more than 6 months duration in patients with a family history of migraine and in nonprogressive migraine attacks.

Complicated Migraine (Those with Neurologic Deficit)

Because the presenting signs and symptoms of complicated migraines with focal neurologic findings cannot be discriminated from similar presentations related to intracranial neoplasms, imaging is recommended. In ophthalmologic migraine with focal neurologic symptoms of unilateral ptosis or complete third-nerve palsy, imaging is recommended to exclude other intracranial abnormalities.

In patients with miscellaneous migraine findings or syndromes such as in vertigo, basilar artery migraine syndrome, persistent confusion migraine syndrome, progressive chronic headache, or hemiplegic migraine, imaging may be appropriate to exclude an aneurysm, a space-occupying lesion, or other intracranial abnormality.

Sinogenic Headache

Sinus disease may present with headache or may be associated with it. The diagnosis of acute sinusitis in children is made clinically; however, in children who present with severe and persistent headache as the dominant feature of sinusitis, imaging may be warranted. Clinical signs suggesting intracranial abnormality include high fever, confusion, and change in mental status with and without focal signs. Headache is the most common symptom identified with the intracranial spread of infection resulting from dural irritation and localized encephalitis. Occasionally, patients who present with various primary headache syndromes without significant nasal or sinus symptoms and fail to respond to conventional therapy are found to have evidence of sinusitis on CT.

Epidural empyemas are collections of suppurative fluid located between the skull and dura. They are less prevalent in young children than in adolescents. The most common underlying abnormality is paranasal sinusitis. The differential diagnosis includes meningitis, subdural and subarachnoid bleeding, and brain abscess. Imaging is decisive and aids treatment. The diagnostic choice is either CT or magnetic resonance imaging (MRI). Contrast enhancement can increase the conspicuousness of a subtle collection. MRI may be preferable for diagnosing epidural empyemas because of its ability to distinguish between different types of fluid.

Trauma

Clearly, intracranial imaging plays a critical role in the evaluation of the acutely injured patient; however, because headache is rarely a major indication for imaging, in the context of this Appropriateness Criteria® topic, only the evaluation of headache related to subacute or remote trauma will be considered.

Patients who have a history of subacute or remote trauma may present with headaches. Currently, there is no published series evaluating headaches that correlate neurologic signs and symptoms with imaging findings. However, in adults, the complaint of headache has been associated with an increased risk of intracranial injury, even in patients suffering minor head trauma with Glasgow coma scores greater than 13. Thus, in children who have had previous minor head trauma and who are awake and alert with no neurological deficit, the indications for CT or MRI are not clear. Certainly, it would be prudent to consider imaging of patients in whom neurologic signs or symptoms are positive, whose headaches are associated with vomiting, or whose headaches are increasing in frequency, duration, or severity, regardless of the severity of the initial trauma.

Headache with Fever or Known Underlying Disease

Headache may accompany a febrile illness. Additional testing may be required when meningitis or encephalitis is suspected. Neurologic signs and symptoms such as nuchal rigidity or alteration in consciousness may be indications for imaging. In addition, there are known underlying disease processes that predispose patients to intracranial pathology. Children with underlying disease -- such as immunocompromised patients, children with known neoplasms, sickle cell patients, and patients with coagulopathy or hypertension -- are predisposed to intracranial pathology. In high-risk groups, the presence of a severe headache may indicate significant intracranial pathology. It would seem appropriate to consider a lower threshold for imaging in this patient population.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF, also known as nephrogenic fibrosing dermopathy) was first identified in 1997 and has recently generated substantial concern among radiologists, referring doctors and lay people. Until the last few years, gadolinium-based MR contrast agents were widely believed to be almost universally well tolerated, extremely safe and non-nephrotoxic, even when used in patients with impaired renal function. All available experience suggests that these agents remain generally very safe, but recently some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed NSF, a syndrome that can be fatal. Further studies are necessary to determine what the exact relationships are between gadolinium-containing contrast agents, their specific components and stoichiometry, patient renal function and NSF. Current theory links the development of NSF to the administration of relatively high doses (e.g., >0.2 mM/kg) and to agents in which the gadolinium is least strongly chelated. The U.S. Food and Drug Administration (FDA) has recently issued a "black box" warning concerning these contrast agents (http://www.fda.gov/cder/drug/InfoSheets/HCP/gcca_200705HCP.pdf).

This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated glomerular filtration rate [GFR] <30 mL/min/1.73m^2), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s).

Abbreviations

- CT, computed tomography
- CTA, CT angiography
- INV, invasive
- LP, lumbar puncture
- MRA, magnetic resonance angiography
- MRI, magnetic resonance imaging

Relative Radiation Level	Effective Dose Estimated Range
None	0
Minimal	<0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Selection of appropriate radiologic imaging procedures for evaluation of children with headache

POTENTIAL HARMS

Some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed nephrogenic systemic fibrosis (NSF), a syndrome that can be fatal. The U.S. Food and Drug Administration (FDA) has recently issued a "black box" warning concerning these contrast agents. This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated glomerular filtration rate [GFR] <30 mL/min/1.73m^2), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s).

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the American College of Radiology (ACR) Appropriateness Criteria® Radiation Dose Assessment Introduction document (see "Availability of Companion Documents" field).

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should

dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Prince JS, Gunderman R, Coley BD, Blatt ER, Bulas D, Fordham L, Karmazyn BK, Podberesky DJ, Paidas C, Rodriguez W, Expert Panel on Pediatric Imaging. ACR Appropriateness Criteria® headache--child. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 6 p. [38 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1999 (revised 2008)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

GUIDELINE COMMITTEE

Committee on Appropriateness Criteria, Expert Panel on Pediatric Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: Jeffrey Scott Prince, MD; Richard Gunderman, MD, PhD; Brian D. Coley, MD; Ellen R. Blatt, MD; Dorothy Bulas, MD; Lynn Fordham, MD; Boaz K. Karmazyn, MD; Daniel J. Podberesky, MD; Charles Paidas, MD; William Rodriguez, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Strain JD, Cohen HL, Fordham L, Gunderman R, McAlister WH, Slovis TL, Smith WL, Rothner AD, Expert Panel on Pediatric Imaging. Headache--child. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 6 p. [36 references]

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

ACR Appropriateness Criteria® *Anytime*, *Anywhere*™ (PDA application). Available from the ACR Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria® radiation dose assessment introduction. American College of Radiology. 2 p. Electronic copies: Available from the American College of Radiology Web site.

PATIENT RESOURCES

None available

NGC STATUS

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